

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0303601F Title: Milstar Satellite Communications System (AF Terminals)  
 DoD Mission Area: 333 - Strategic Communications Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): (\$ in thousands)

Project Number	Title	FY 1987 Actual	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		258,562	198,226	310,347	Continuing	N/A
2487	Milstar(AF Terminals)	258,562	198,226	310,347	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops and acquires Air Force Satellite Communications (AFSATCOM) Ultra High Frequency terminal modifications, transponder test set upgrades, and gap filler AFSATCOM payloads, required for transition to the Milstar satellite system. It also provides resources for development/ acquisition of Milstar Extremely High Frequency terminals for the Air Force. The Milstar satellite system will provide a highly survivable, jam-resistant, worldwide, secure communications system to support the President and the military Commanders-in-Chief for command and control of selected United States strategic and tactical forces in all levels of conflict.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: (\$ in thousands)

RDT&E	271,968	229,229	310,353	Continuing	N/A
Aircraft Procurement	0	2,900	21,673	Continuing	N/A
Other Procurement	725	129	59,681	Continuing	N/A

EXPLANATION: (U) FY88 RDT&E reductions Congressionally mandated. Procurement increases implements FY88 Appropriation Conference language accelerating Milstar program.

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4. (U) OTHER APPROPRIATION FUNDS: (\$ in thousands)

	<u>FY 1987 Actual</u>	<u>FY 1988 Estimate</u>	<u>FY 1989 Estimate</u>	<u>Additional to Completion</u>	<u>Total Estimated Cost</u>
Aircraft Procurement Funds	0	0	21,673	Continuing	N/A
Quantities (terminals).			2		
Other Procurement Funds	725	129	77,099	Continuing	N/A
Quantities (terminals)	0	0	4		
Military Construction Funds	0	0	4,000	Continuing	N/A

5. (U) RELATED ACTIVITIES: Missile Procurement funding in FY 1991 and following procures additional Ultra High Frequency (UHF) transponders on classified host spacecraft to maintain the current Air Force Satellite Communications (AFSATCOM) UHF capability. Procurement and installation of transition upgrades to airborne AFSATCOM terminals to allow UHF compatibility with the Milstar system are funded within the modification line of each weapon system Program Element (PE). Approved transition users include the following PE's: PE 0101113F, B-52 Squadrons; PE 0101115F, B-1B; PE 0101213F, Minuteman Squadrons; PE 0101312F, Post Attack Command and Control System/World Wide Airborne Command Post (EC-135); PE 0208019F, Tactical Cryptologic Activities (RC-135); and PE 0302015F, National Emergency Airborne Command Post/E-4B Class V Mods. PE 0303603F, Milstar Satellite Communications System (Space and Mission Control), will develop and acquire the spacecraft and mission control segments for this highly survivable, jam-resistant, worldwide command and control communications system.

6. (U) WORK PERFORMED BY: Selected terminal modifications for transition of the AFSATCOM system to Milstar are being developed and produced by Rockwell International, Santa Ana, CA, and Linkabit Corp, La Jolla, CA. Remaining AFSATCOM terminal modifications and the Air Force Milstar EHF terminals are being developed by the Raytheon Company, Sudbury, MA., teamed with Rockwell Collins of Cedar Rapids, IA. and Bell Aerospace of Buffalo, NY. Federal Contract Research Center support is provided by the MITRE Corporation, Bedford, MA, and Lincoln Laboratory, Lexington, MA.

7. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1989: Not Applicable.

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8. (U) SINGLE PROJECT OVER \$10 MILLION IN FY 1989:

(U) Project: #2487, Milstar Satellite Communications System (AF Terminals)

A. (U) Project Description: The upgrade of Air Force Satellite Communications (AFSATCOM) to Milstar involves both command post and force element terminals and is being executed in multiple steps to maintain strategic connectivity during the transition. Command post terminals in EC-135 aircraft and at selected ground locations will be upgraded to the Milstar Ultra High Frequency (UHF) modulation compatibility in FY 1989-FY 1990 to allow immediate use of the on-orbit Single Channel Transponders and early use of Milstar satellites. These same terminals plus mobile command posts and satellite mission control elements will be upgraded to full Extremely High Frequency (EHF)/UHF capability. Nine EC-135C command post aircraft are planned to receive early EHF/UHF Engineering Development Model allowing an early EHF injection capability (EHF uplink, UHF downlink) into the first Milstar satellites. The remaining command posts (EC-135H/J/P, E-4B, E-6) will receive full capability starting in FY 1992. Force element terminals will receive the UHF Dual Modem Upgrade starting in FY 1987 and it is expected that at least 450 force element aircraft (B-52, B-1B, EC135A/C, RC135, etc.) will have Milstar UHF capability prior to launch of the first satellite. Finally, force elements will be upgraded to EHF by the mid 1990's providing full jam and scintillation resistant communications capability.

B. (U) Program Accomplishments and Future Efforts:

(U) (1) FY 1987 Accomplishments: Installation of Milstar upgrades to command post and force element AFSATCOM terminals continued. Field Development Test and Evaluation of the UHF transition command post terminal was completed. Fabrication and integration of three qualification model EHF-EHF/UHF terminals was completed and qualification and reliability tests performed. Began in-plant developmental testing and evaluation of EHF terminals using the Fleet Satellite (FLTSAT) Communications System EHF transponder package successfully placed into orbit on FLTSAT 7 on 4 December 1986. The upgrade of AFSATCOM host vehicle transponder test equipment began. Additional high inclination AFSATCOM transponders are required in the mid-1990's to maintain strategic connectivity if existing assets survive only to their predicted design life. The existing AFSATCOM transponder design must be upgraded to replace components no longer available. Upgrading the test equipment allows design and test of a new UHF transponder for host satellites and provides an enhanced capability for testing transponders already on orbit. Requirements definition and architecture for a Low Volume EHF Terminal (LVT) was completed. The LVT design goal for aircraft is 300 pounds as compared with 800 pounds for the standard Milstar EHF terminal. The goal for ground LVT's is 200 pounds with a very limited capability 50 pound terminal possible. These

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miniaturized terminals will meet requirements for National Command Authority, advanced aircraft, special forces, and classified survivable communications.

(2) (U) FY 1988 Program: Begin development of the upgraded Air Force Satellite Communications (AFSATCOM) transponder by the host program office. Begin technology insertion development for the LVT. Continue installation of force element and command post Ultra High Frequency (UHF) radio upgrades to permit fast frequency hopping will begin. The installation of UHF upgrades in force element aircraft and ground terminals as well as production of UHF transition terminals for command posts. Prototype standard terminals will be tested against EHF transponders aboard Navy Fleet Satellites to support a Low Rate Initial Production (LRIP) decision. Most RDT&E funds will be applied to the fabrication and deployment of Engineering Development Model (EDM) terminals for EC-135C aircraft and selected ground sites. These EDM terminals will provide an early capability for very jam resistant cross band operation (Extremely High Frequency (EHF) uplink and UHF downlink) with force element terminals. Additional RDT&E will be applied to fabrication and assembly of advanced antennas subsystems for Peacekeeper missile systems currently in the design phase. An Independent Cost Assessment for the core standard terminal program was performed and the results presented to the Office of the Secretary of Defense Cost Analysis Improvement Group on 1 February 1985. The cost estimates for the LVT and AFSATCOM transponder development programs are currently Category III, Budgetary. The cost estimate for the core standard terminal program is Category I, Comprehensive.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Funding of AFSATCOM transponder development will continue. Begin design of the LVT. Development of special antennas for advanced aircraft and non-standard ground applications will continue. Begin installation of command post UHF upgrades. The Initial Operating Capability for the improved AFSATCOM UHF Single Channel Transponder Injection System will be reached. Production and installation of EDM EHF terminals will continue. Perform "turn key" installation at Offutt AFB. LRIP of EHF terminals will begin for planned installation beginning in FY 1991. The cost estimates for the LVT and AFSATCOM transponder development programs are currently Category III, Budgetary. The cost estimate for the standard EHF and EHF/UHF terminal development program is Category I, Comprehensive.

(4) (U) Program to Completion: This is a continuing program.

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C. (U) Major Milestones:

<u>Milestones</u>	<u>Dates</u>
(1) (U) Milstar Terminal Full Scale Development (FSD) Start	September 1983
(2) (U) Extremely High Frequency (EHF) Preliminary Design Review	June 1984
(3) (U) EHF Terminal Critical Design Review	February 1985
(4) (U) Phase II FSD Contract Award	May 1985
(5) (U) Start of EHF Terminal Qualification Model Integration	August 1986
(6) (U) Milstar Low Rate Initial Production Start	FY 1989

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

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AS OF: February 1988

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E):

(U) Test Schedule

(U) Air Force Satellite Communications System (AFSATCOM) Upgrade Testing	FY86/87
(U) In-plant DT&E:	FY86/88
- Brassboard/Prototype Testing	FY86/87
- On Orbit Transponder Tests	FY88
- Reliability/Growth Tests	FY89

( Field DT&E/Initial Operational Test & Evaluation (IOT&E)

[ ]

(U) AFSATCOM Terminal Dual Modem/ARC-171 Upgrade - To prevent loss of communications during transition from the existing AFSATCOM Ultra High Frequency (UHF) communications system and the new Milstar Extremely High Frequency (EHF) system, existing AFSATCOM terminals are being upgraded to be compatible with the limited UHF capability on the Milstar satellite and jam resistant modes on Single Channel Transponders now present on a variety of host spacecraft. The modifications involve replacement of several circuit boards in existing AFSATCOM modulator-demodulator (MODEM) units and minor ARC-171 radio modifications. Backward compatibility to AFSATCOM is maintained. Most developmental testing of the Dual Modem and ARC-171 radio modifications has been completed and there are no significant discrepancies.

(U) Milstar Terminals - The Air Force awarded a contract for the second phase (post Critical Design Review) of terminal Full Scale Development to the Raytheon Company, Sudbury, Massachusetts in June 1985. Major subcontractors include the Rockwell International, Advanced Communication & Countermeasures Division of Santa Anna, California and Bell Aerospace Textron of Buffalo, New York. The Air Force Milstar Terminal Program Office at Electronic Systems Division has formed a Terminal Test Planning Working Group to coordinate test issues. Detailed test plans arrived to support the February 1985 Critical Design Review. In-plant developmental testing will be accomplished with factory test equipment and complimented by the Milstar Design Verification Model and satellite test sets. Field level testing will begin first with the FLTSAT Extremely High Frequency packages and later with the Milstar satellites.

2. (U) Operational Test and Evaluation (OT&E): (See also Program Element 33603F Milstar Satellite Communications Program.)

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(U) The Milstar Air Force Terminal Initial Operational Test and Evaluation (IOT&E), managed by the Air Force Operational Test and Evaluation Center (AFOTEC), performs operational assessments supporting Low Rate Initial Production and full scale production decision. Also, the Air Force terminal will be reevaluated from an overall system perspective during Milstar Multiservice IOT&E. In addition to the future efforts described above, AFOTEC conducted an IOT&E(1) on the Air Force terminal which was completed in November 1985.

(U) IOT&E(1) results were published in the Milstar Air Force Terminal IOT&E(1) final report dated November 1985. The primary purpose of the IOT&E(1) was to identify and report any problem areas, risks, and shortcomings of the Milstar Air Force terminal program in fulfilling user operational requirements. IOT&E(1) was accomplished by review of program documentation and participation in key meetings, design reviews, and source selection. In the November 1985 final report, AFOTEC listed five concerns which have since been resolved.

(1) (U) Software security measures being used by contractors during development of the AF terminal software were inadequate. However, the terminal program office, working with the Computer Resources Working Group, strengthened security procedures. Under the new program, terminal software is developed in a vaulted area, extensive software reviews have been instituted, access to the software is strictly controlled, and the contractor has been trained and is fully supportive of software security procedures.

(2) (U) Logistics Support Analysis (LSA) was not being accomplished correctly by contractors. The program office has updated and verified the LSA "A" sheet to reflect more accurate estimates. The update is on revision "G" and is an iterative cycle.

(3) (U) Terminal diagnostic design was inadequate to assure complete fault detection/fault isolation of terminal failures. This problem has been resolved and there is now a fully integrated approach with extensive Built-In-Test at the terminal level as well as Modular Automated Test Equipment (MATE) at the Intermediate and Depot maintenance levels. Compatible software design within the terminal and MATE system will reduce non-reproducible errors.

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(5) (U) AFOTEC reported that the threat to Milstar was not baselined into Milstar system specifications and that threat documentation did not address the total threat. A new, more detailed Milstar System Threat Assessment Report (STAR) is in process and currently in Defense Intelligence Agency coordination. The new assessment addresses the total system and will permit the specifications to be properly updated, if required.

(U) The operational assessment to support the LRIP will be based on monitoring in-plant DT&E testing, review of DT&E test results, a combined DT&E/OT&E terminal interoperability demonstration, participation in the LSA process, and some limited OT&E analysis in the survivability area. The purpose of the assessment is to estimate the terminal's operational effectiveness and suitability in meeting operational requirements. Test assets will include in-plant engineering development model terminals, the prototype FLEETSATCOM ENF Package (FEP) at MIT Lincoln Laboratory, the on-orbit FEP, and the development verification model (DVM) Milstar communications payload at TRW, Redondo Beach, CA. The in-plant DT&E tests which will be monitored include terminal contact item box level testing, terminal prime item performance testing, and system integration testing with the prototype FEP, and the Milstar DVM. Interoperability between AF terminal and the Army and Navy terminals will be assessed via an interoperability demonstration that will be conducted as a combined DT&E/OT&E effort. The assessment will conclude fall 1988 and will support a LRIP decision which is planned for November 1988.

(U) The AF terminal OT&E will involve both combined DT&E/OT&E and dedicated IOT&E. The combined DT&E/OT&E will be conducted in conjunction with the terminal developer Air Force Electronic Systems Division (ESD) and will involve monitoring field DT&E of three terminal configurations communicating first with the on-orbit FEP and then finally with on-orbit Milstar. Preceding the full scale production decision, AFOTEC will conduct a dedicated IOT&E of the terminal. The dedicated IOT&E will involve evaluating the operational effectiveness and suitability of the terminal against operational thresholds. The dedicated test will be conducted in a representative operational environment using several production representative terminals communicating with an on-orbit Milstar satellite. Interoperability between the AF terminal and the Army and Navy terminals will be evaluated by setting up representative networks between the three terminal types through the on-orbit Milstar satellite. This testing will be conducted by an Air Force test team which will be initially formed in FY88 and fully staffed by FY90.



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3. ( System Characteristics:

<u>Characteristic</u>	<u>Objective/Threshold</u>	<u>Demonstrated</u>
EHF Max Data Rate (kilo-bits/sec)	[ ]	To be demonstrated
Bit Error Rate (EHF fully processed)		To be demonstrated
Bit Error Rate (EHF partially processed)		To be demonstrated
Bit Error Rate (Ultra High Frequency)		To be demonstrated
Anti-Jam Protection, degradation in deci-bells of Energy-Per-Bit/Noise-Energy for specialized jamming (pulse, chirp, partial band tone, partial band noise.) at $10^{-5}$ decoded bit-error rate.		To be demonstrated
Terminal Mission Availability (12 hour mission)	.96	To be demonstrated

4. (U) Current Test and Evaluation (T&E):

<u>Event</u>	<u>T&amp;E Activity (Past 12 Months)</u>		<u>Remarks</u>
	<u>Planned Activity</u>	<u>Actual/Predicted Date</u>	
Complete LRIP Test Approach	Jun 87	Jun 87	Approved by DOT&E Jun 87
Begin LRIP Assessment	Jul 87	Jul 87	None
Form LRIP Cadre	Jul 87	Jul 87	Two Officers Placed at ESD
Test Program Outline	Dec 87	Jan 88	None

<u>Event</u>	<u>T&amp;E Activity (Next 12 Months)</u>		<u>Remarks</u>
	<u>Planned Date</u>		
Finalize LRIP Test Plan	Feb 88		None
Complete OT&E Test Approach	May 88		None
Test Plan Outline (TPO) Revision	Jun 88		None
Activate OT&E Test Cadre	Oct 88		None
Test Plan Outline (TPO) Revision	Dec 88		None